I, Takao Suzuki, fluent both in Japanese and English, hereby swear that to the best of my knowledge, the attached is a true translation of Japanese Patent Application No. 2003-142861 filed in the Japanese Patent Office on May 21, 2003.

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7/6/06

Japanese Patent Application No. 2003-142861 filed in the Japanese Patent Office on May 21, 2003

[Document Name] Specification

[Title of the Invention] Sheet Processing Apparatus

[Scope of Claims]

[Claim 1] A sheet processing apparatus receiving and binding sheets discharged from an image forming apparatus and discharging the sheets, the apparatus comprising:

a binding tray; and

a first roller pair and a second roller pair provided between the image forming apparatus and the binding tray,

wherein the second roller pair is intermittently rotated, and thereby the sheets conveyed from the first roller pair one after another are pinched by the second roller pair one after another while being overlapped one upon another with leading edges thereof shifted stepwise one after another and are held by the second roller pair to be further conveyed.

[Claim 2] A sheet processing apparatus receiving and binding sheets discharged from an image forming apparatus and discharging the sheets, the apparatus comprising:

a binding tray; and

a first roller pair and a second roller pair provided between the image forming apparatus and the binding tray,

wherein the second roller pair is rotated at a circumferential speed that is slower than that of the first roller pair, and thereby the sheets conveyed from the first

roller pair one after another are pinched by the second roller pair one after another while being overlapped one upon another with leading edges thereof shifted stepwise one after another and are held by the second roller pair to be further conveyed.

[Claim 3] A sheet processing apparatus receiving and binding sheets discharged from an image forming apparatus and discharging the sheets, the apparatus comprising:

a binding tray;

a first roller pair and a second roller pair provided between the image forming apparatus and the binding tray;

a device causing the sheets conveyed from the first roller pair one after another to be pinched and held by the second roller pair one after another while being overlapped one upon another with leading edges thereof shifted stepwise one after another;

a conveying path provided between the first roller pair and the second roller pair; and

an open area provided to the conveying path for causing a trailing edge of each of the sheets pinched and held by the second roller pair while being overlapped one upon another with leading edges thereof shifted stepwise one after another to retreat from the conveying path.

[Claim 4] A sheet processing apparatus receiving and binding sheets discharged from an image forming apparatus and discharging the sheets, the apparatus comprising:

a binding tray;

a first roller pair and a second roller pair provided between the image forming apparatus and the binding tray;

a device causing the sheets conveyed from the first roller pair one after another to be pinched and held by the second roller pair one after another while being overlapped one upon another with leading edges thereof shifted stepwise one after another;

a conveying path provided between the first roller pair and the second roller pair;

an open area provided to the conveying path for causing a trailing edge of each of the sheets pinched and held by the second roller pair while being overlapped one upon another with leading edges thereof shifted stepwise one after another to retreat from the conveying path; and

a discharging device configured to cause the trailing edge of each of the sheets pinched and held by the second roller pair while being overlapped one upon another with leading edges thereof shifted stepwise one after another to retreat from the conveying path to the open area.

[Claim 5] A sheet processing apparatus receiving and binding sheets discharged from an image forming apparatus and discharging the sheets, the apparatus comprising:

a binding tray;

a first roller pair and a second roller pair provided between the image forming apparatus and the binding tray;

a conveying path provided between the first roller pair and the second roller pair;

an open area provided to the conveying path;

a device causing the sheets conveyed from the first roller pair one after another to be pinched and held by the second roller

pair one after another while being overlapped one upon another with leading edges thereof shifted stepwise one after another; and

a bulging device provided to the conveying path to cause each of the sheets, conveyed from the first roller pair one after another and pinched and held by the second roller pair one after another, to bulge.

[Claim 6] A sheet processing apparatus receiving and binding sheets discharged from an image forming apparatus and discharging the sheets, the apparatus comprising:

a binding tray;

a first roller pair and a second roller pair provided between the image forming apparatus and the binding tray;

a conveying path provided between the first roller pair and the second roller pair;

an open area provided to the conveying path; and

a device causing the sheets conveyed from the first roller pair one after another to be pinched and held by the second roller pair one after another while being overlapped one upon another with leading edges thereof shifted stepwise one after another,

wherein the open area is widely opened so that each of the sheets pinched and held by the second roller pair bulges toward the open area and a trailing edge thereof is discharged, and

wherein the apparatus further comprises a moving guide device configured to guide each of the sheets conveyed from the first roller pair.

[Claim 7] A sheet processing apparatus receiving and

binding sheets discharged from an image forming apparatus and discharging the sheets, the apparatus comprising:

a binding tray;

a first roller pair and a second roller pair provided between the image forming apparatus and the binding tray; and

a binding device configured to bind the sheets discharged from the second roller pair on the binding tray,

wherein when the binding device is not performing a processing operation, the first roller pair and the second roller pair perform normal conveying of the sheets and when the binding device is performing the processing operation, the second roller pair is in a waiting state in which the sheets conveyed from the first roller pair one after another are pinched by the second roller pair one after another while being overlapped one upon another with leading edges thereof shifted stepwise one after another and are held by the second roller pair to be further conveyed.

[Claim 8] A sheet processing apparatus receiving and binding sheets discharged from an image forming apparatus and discharging the sheets, the apparatus comprising:

a binding tray;

a first roller pair and a second roller pair provided between the image forming apparatus and the binding tray; and

a binding device configured to bind the sheets discharged from the second roller pair on the binding tray,

wherein sheets discharged from the image forming apparatus while the binding device is performing a processing operation

are pinched and held by the second roller pair one after another while being overlapped one upon another with leading edges thereof shifted stepwise one after another, and the sheets pinched and held by the second roller pair are discharged onto the binding tray after completion of the processing operation of the binding device according to an instruction from a controller.

[Claim 9] A sheet processing apparatus receiving and binding sheets discharged from an image forming apparatus and discharging the sheets, the apparatus comprising:

a binding tray;

a first roller pair configured to convey the sheets discharged from the image forming apparatus;

a second roller pair configured to perform a function of conveying the sheets in substantially the same manner as the first roller pair and a function of pinching and holding the sheets conveyed from the first roller pair one after another such that the sheets are overlapped one upon another with leading edges thereof shifted stepwise one after another;

a binding device configured to jog and bind the sheets discharged from the second roller pair on the binding tray; and

a discharging device discharging the sheets bound by the binding device to a discharging outlet,

wherein when a trouble has occurred in the binding device and/or the discharging device, sheets discharged from the image forming apparatus are pinched by the second roller pair one after another while being overlapped one upon another with

leading edges thereof shifted stepwise one after another and are held by the second roller pair to be further conveyed.

[Detailed Description of the Invention]

[0001]

[Technical Field of the Invention]

The present invention relates to a sheet processing apparatus used in connection with an image forming apparatus such as a copier, a duplicator, a printer, etc.

[0002]

[Conventional Art]

Heretofore, it has been known that a sheet processing apparatus connected with an image forming apparatus such as a copier, a printer, etc. conveys sheets discharged from the image forming apparatus to a sheet sorting device one after another, sorts the sheets, and performs post-processing of sorted groups of sheets with a binding device, a punching device, etc. While the post-processing is being performed at the sheet processing apparatus, the image forming operation of the image forming apparatus is stopped. It has been also known that in the case of a binding apparatus connected with an image forming apparatus, image formation of the image forming apparatus is temporarily stopped while a binding operation is being performed.

[0003]

In the present circumstances, the sheet discharging speed of the image forming apparatus is relatively high, and when the sheet processing apparatus is performing processing, for example, binding, there is no other choice than temporarily

stopping the image forming operation of the image forming apparatus. The lengths of the sheet conveyance path within the image forming apparatus and the conveyance path to a binding tray of the binding device of the sheet processing apparatus are relatively long, and to cope with future increasing of the discharging speed of the image forming apparatus, while it is conceivable that the processing speed of the sheet processing apparatus is increased, a sheet waiting device in which a relatively large number of sheets received from the image forming apparatus are temporarily held will be required.

[0004]

[Problems to be solved by the Present Invention]

In a sheet processing apparatus, there has been a problem that while a binding operation is being performed on a binding tray of the sheet processing apparatus, sheets discharged from an image forming apparatus cannot be received onto the binding tray. Consequently, image formation at the image forming apparatus is stopped, so that loss time has been large and productivity has been low. As the countermeasure for such a problem, increasing the processing speed of the sheet processing apparatus is important, however, there has been a problem that a waiting device, that is capable of holding a sufficient number of sheets, on which images have been formed at the image forming apparatus, while the sheet processing apparatus is performing processing, has not been provided. Further, there has been a problem that when jamming has occurred at a discharging part discharging a bound book or a trouble has

occurred in the binding operation, the sheet processing apparatus and the image forming apparatus are stopped, so that removing sheets existing in each conveyance path becomes a troublesome work.

[0005]

In view of the above-discussed problems, the present invention mainly aims that in a sheet processing apparatus receiving a predetermined number of sheets, on which images have been formed and discharged from an image forming apparatus, in a binding tray, performing a binding operation, and discharging a bound stack of sheets, when sheets of a next binding set of sheets are conveyed into the sheet processing apparatus while the sheet processing apparatus is performing the binding operation, the sheets of a next binding set of sheets are held by a waiting device provided above the binding tray in the order that the sheets have been conveyed and the held sheets are conveyed to the binding tray immediately after completion of the binding operation, so that binding of the next biding set of sheets can be performed in succession without stopping the image forming apparatus, and thereby the productivity is efficiently increased. Further, when the operations of the binding tray, a binding part, and/or a discharging part, which are located at the downstream side of the waiting part, have been stopped due to problems occurred at respective parts, the operation at the image forming apparatus being performed at that occasion is completed without being stopped and sheets being processed are conveyed to the waiting part and are held there.

Thereby, a troublesome work of removing sheets in the conveyance path within the image forming apparatus as jammed sheets is eliminated.

[0006]

[Means for Solving the Problems]

According to the invention of Claim 1, a sheet processing apparatus, which receives and binds sheets discharged from an image forming apparatus and discharges the sheets, includes a binding tray, and a first roller pair and a second roller pair provided between the image forming apparatus and the binding tray. The second roller pair is intermittently rotated, and thereby the sheets conveyed from the first roller pair one after another are pinched by the second roller pair one after another while being overlapped one upon another with leading edges thereof shifted stepwise one after another and are held by the second roller pair to be further conveyed.

[0007]

According to the invention of Claim 2, a sheet processing apparatus, which receives and binds sheets discharged from an image forming apparatus and discharges the sheets, includes a binding tray, and a first roller pair and a second roller pair provided between the image forming apparatus and the binding tray. The second roller pair is rotated at a circumferential speed that is slower than that of the first roller pair, and thereby the sheets conveyed from the first roller pair one after another are pinched by the second roller pair one after another while being overlapped one upon another with leading edges

thereof shifted stepwise one after another and are held by the second roller pair to be further conveyed.

[0008]

According to the invention of Claim 3, a sheet processing apparatus, which receives and binds sheets discharged from an image forming apparatus and discharges the sheets, includes a binding tray, a first roller pair and a second roller pair provided between the image forming apparatus and the binding tray, a device causing the sheets conveyed from the first roller pair one after another to be pinched and held by the second roller pair one after another while being overlapped one upon another with leading edges thereof shifted stepwise one after another, a conveying path provided between the first roller pair and the second roller pair, and an open area provided to the conveying path for causing a trailing edge of each of the sheets pinched and held by the second roller pair while being overlapped one upon another with leading edges thereof shifted stepwise one after another to retreat from the conveying path.

[0009]

According to the invention of Claim 4, a sheet processing apparatus, which receives and binds sheets discharged from an image forming apparatus and discharges the sheets, includes a binding tray, a first roller pair and a second roller pair provided between the image forming apparatus and the binding tray, a device causing the sheets conveyed from the first roller pair one after another to be pinched and held by the second roller pair one after another while being overlapped one upon another

with leading edges thereof shifted stepwise one after another, a conveying path provided between the first roller pair and the second roller pair, an open area provided to the conveying path for causing a trailing edge of each of the sheets pinched and held by the second roller pair while being overlapped one upon another with leading edges thereof shifted stepwise one after another to retreat from the conveying path, and a discharging device configured to cause the trailing edge of each of the sheets pinched and held by the second roller pair while being overlapped one upon another with leading edges thereof shifted stepwise one after another to retreat from the conveying path to the open area.

[0010]

According to the invention of Claim 5, a sheet processing apparatus, which receives and binds sheets discharged from an image forming apparatus and discharges the sheets, includes a binding tray, a first roller pair and a second roller pair provided between the image forming apparatus and the binding tray, a conveying path provided between the first roller pair and the second roller pair, an open area provided to the conveying path, a device causing the sheets conveyed from the first roller pair one after another to be pinched and held by the second roller pair one after another while being overlapped one upon another with leading edges thereof shifted stepwise one after another, and a bulging device provided to the conveying path to cause each of the sheets, conveyed from the first roller pair one after another and pinched and held by the

second roller pair one after another, to bulge.

[0011]

According to the invention of Claim 6, a sheet processing apparatus, which receives and binds sheets discharged from an image forming apparatus and discharges the sheets, includes a binding tray, a first roller pair and a second roller pair provided between the image forming apparatus and the binding tray, a conveying path provided between the first roller pair and the second roller pair, an open area provided to the conveying path, and a device causing the sheets conveyed from the first roller pair one after another to be pinched and held by the second roller pair one after another while being overlapped one upon another with leading edges thereof shifted stepwise one after another. The open area is widely opened so that each of the sheets pinched and held by the second roller pair bulges toward the open area and a trailing edge thereof is discharged, and the apparatus further includes a moving guide device configured to guide each of the sheets conveyed from the first roller pair.

[0012]

According to the invention of Claim 7, a sheet processing apparatus, which receives and binds sheets discharged from an image forming apparatus and discharges the sheets, includes a binding tray, a first roller pair and a second roller pair provided between the image forming apparatus and the binding tray, and a binding device configured to bind the sheets discharged from the second roller pair on the binding tray.

When the binding device is not performing a processing operation, the first roller pair and the second roller pair perform normal conveying of the sheets and when the binding device is performing the processing operation, the second roller pair is in a waiting state in which the sheets conveyed from the first roller pair one after another are pinched by the second roller pair one after another while being overlapped one upon another with leading edges thereof shifted stepwise one after another and are held by the second roller pair to be further conveyed.

[0013]

According to the invention of Claim 8, a sheet processing apparatus, which receives and binds sheets discharged from an image forming apparatus and discharges the sheets, includes a binding tray, a first roller pair and a second roller pair provided between the image forming apparatus and the binding tray, and a binding device configured to bind the sheets discharged from the second roller pair on the binding tray. Sheets discharged from the image forming apparatus while the binding device is performing a processing operation are pinched and held by the second roller pair one after another while being overlapped one upon another with leading edges thereof shifted stepwise one after another, and the sheets pinched and held by the second roller pair are discharged onto the binding tray after completion of the processing operation of the binding device according to an instruction from a controller.

[0014]

According to the invention of Claim 9, a sheet processing

apparatus, which receives and binds sheets discharged from an image forming apparatus and discharges the sheets, includes a binding tray, a first roller pair configured to convey the sheets discharged from the image forming apparatus, a second roller pair configured to perform conveying the sheets in substantially the same manner as the first roller pair and pinching and holding the sheets conveyed from the first roller pair one after another such that the sheets are overlapped one upon another with leading edges thereof shifted stepwise one after another, a binding device configured to jog and bind the sheets discharged from the second roller pair on the binding tray, and a discharging device discharging the sheets bound by the binding device to a discharging outlet. When a trouble has occurred in the binding device and/or the discharging device, sheets discharged from the image forming apparatus are pinched by the second roller pair one after another while being overlapped one upon another with leading edges thereof shifted stepwise one after another and are held by the second roller pair to be further conveyed.

[0015]

[Embodiments of the Invention]

Herein below, the embodiments of a sheet processing apparatus according to the present invention are described referring to attached drawings.

[0016]

FIG. 1 is a schematic diagram of a sheet processing apparatus according to an embodiment of the present invention,

and the numeral 1 denotes an image formation controller (hereinafter called a PC), the numeral 2 denotes an image forming apparatus (hereinafter called a printer), and the numeral 3 denotes the sheet processing apparatus.

[0017]

The PC 1 includes a display, an operation keyboard, a scanner, etc., and performs generation, editing, processing, and reading of images, various settings, such as page setting, setting of the number of copies, etc., and displaying input and selected modes, the status of the apparatus, etc.

[0018]

The PC 1 stores an image read with the scanner, an image sent from an external device, a generated image, etc., and after storing, performs editing and pagination of these images.

The printer 2 as the image forming apparatus includes a sheet feeding device, and forms an image sent from the PC 1 on a sheet conveyed from the sheet feeding device. Generally, the printer 2 forms the image using an ink jet process or electrophotography. The printer 2 feeds out the sheet from the sheet feeding device and forms the image on the sheet according to an instruction from the PC 1, and sends out the sheet as a sheet 4 to the sheet processing apparatus 3.

[0019]

FIG. 2 illustrates a typical exemplary construction of the sheet processing apparatus 3. The sheet processing apparatus 3 includes, as illustrated in figure, a sheet waiting part 6, a jogging part 7, a binding part 8, and a discharging part 9.

The sheet waiting part 6 includes a receiving part 11 and a waiting part 12.

[0020]

The receiving part 11 includes, as illustrated in FIG. 3, an upper guide plate 21 and a lower guide plate 22 that guide the sheet 4 when the sheet 4 has been received, an "A" sensor 24 detecting the received sheet 4, and an "A" roller 25 and a "B" roller 26 serving as a first roller pair of the present invention that conveys the received sheet 4. The A roller 25 is supported with bearings by side plates of a main body of the sheet processing apparatus 3 and pressed by an "A" spring 27, and is placed on the B roller 26. The B roller 26 is rotated by rotation of an "A" pulley 28. The A pulley 28 is rotated via an "A" belt 33 by rotation of a "B" pulley 29 integrally mounted to an axis of an "A" motor 30, which is supported with bearings and mounted to the side plates, and thereby the B roller 26, which is integrally attached to the A pulley 28, is rotated. The A roller 25 and the B roller 26 rotate in directions indicated by arrows in figure, respectively, at a circumferential speed V corresponding to the speed at which the sheet 4 is conveyed from the printer 2.

[0021]

A moving guide plate 23 is usually located at a reference position "G" and is detected by a moving guide plate sensor 36, and is moved to an "H" position and the reference position G with rotation of a "B" motor 35 under control of a control device not shown. The moving guide plate 23 is rotated around an "A"

axis 34 to be moved to the reference position G and the H position with rotation of the B motor 35. An "A" gear 31 mounted to the A axis 34 is engaged with a "B" gear 32 integrated with an axis of the B motor 35 fixed to the side plates of the main body of the sheet processing apparatus 3, so that the moving guide plate 23 is moved to the reference position G and the H position with rotation of the B motor 35.

[0022]

The waiting part 12, which is illustrated in FIG. 3, includes a "C" sensor 44 attached to the upper guide plate 21, a "D" roller 42 located inside of a cover 48 and supported with bearings by the side plates of the main body of the sheet processing apparatus 3, and a "C" roller 41 placed on the D roller 42 and pressed by a "C" spring 43. Gears are integrally mounted to respective axes of the D roller 42 and the C roller 41. A "D" pulley 46 integrated with an axis of a "C" motor 49 mounted to the side plates of the main body of the sheet processing apparatus 3 is rotated with rotation of the C motor 49, a "C" pulley 45 is thereby rotated via a "B" belt 47, and the D roller 42 integrated with the C pulley 45, and the C roller 41 are rotated.

[0023]

The A roller 25 and the B roller 26 of the receiving part 11 as the first roller pair always rotate at the circumferential speed V corresponding to the speed at which the sheet 4 is discharged from the printer 2. The C roller 41 and the D roller 42 as the second roller pair are rotated by the C motor 49, and

are controlled by the control device, not shown, to rotate at the same circumferential speed as that of the A roller 25 and the B roller 26 as the first roller pair, i.e., at the circumferential speed V, usually, and are controlled to perform a standby operation when the binding part 8 is performing a binding operation and when the binding part 8 and/or the discharging part 9 is out of order. For example, the C roller 41 and the D roller 42 as the second roller pair may be rotated at a circumferential speed decreased to about one twentieth of the circumferential speed V of the A roller 25 and the B roller 26, and thereby sheets 4 conveyed by the A roller 25 and the B roller 26 one after another are pinched by the C roller 41 and the D roller 42 one after another while being overlapped one upon another with respective leading edges thereof shifted stepwise one after another and with respective trailing edges thereof discharged to an open area 13, and are held by the C roller 41 and the D roller 42 to be further conveyed. In this method, by decreasing the circumferential speed of the C roller 41 and the D roller 42 as the second roller pair to about one twentieth of that of the A roller 25 and the B roller 26 as the first roller pair, about 20 sheets 4 can be held by the C roller 41 and the D roller 42, so that control is relatively simple. In the method of pinching sheets 4 such that respective leading edges thereof shifted stepwise one after another, the circumferential speed of the C roller 41 and the D roller 42 has been decreased to one twentieth of that of the A roller 25 and the B roller 26, however, the ratio of decreasing the

circumferential speed of the C roller 41 and the D roller 42 relative to that of the A roller 25 and the B roller 26 can be determined between about one half and about one thirtieth of the speed of the A roller 25 and the B roller 26 based on the number of sheets 4 to be held by the C roller 41 and the D roller 42. Further, sheets 4 can be pinched and held by the second roller pair with respective leading edges shifted stepwise one after another by intermittently stopping the second roller pair after rotating a predetermined amount. The second roller pair may be stopped after conveying each sheet 4 by a predetermined distance at the circumferential speed V or at a decreased speed.

[0024]

In the jogging part 7 illustrated in FIG. 4 and FIG. 5, the swinging positions of a tray 51 freely swinging around an "E" axis 52 fixed to the side plates of the main body of the apparatus 3 are set by an upper side stopper 54 and a lower side stopper 55. A link 57, which is connected with an "E" support point 56 mounted to a side plate of the tray 51, is connected with an "F" support point 58 mounted to an "F" gear 60 fixed to an "F" axis 61 supported with bearings by the side plates of the main body, and an "E" gear 59, which is integrated with an axis of an "E" motor 62 mounted to the side plates of the main body, engages with the F gear 60, and the tray 51 is driven to move to an uppermost position "M" and a lowermost position "N" where the tray 51 is illustrated by a dashed line with rotation of the E motor 62 and detection by a sensor 53.

[0025]

In the discharging part 9 illustrated in FIG. 4, a discharging roller 63 is rotated with a "G" gear 66 and an "F" gear 65 engaging with the G gear 66. The G gear 66 is fixed to an axis of an "F" motor 67 mounted to the side plates of the main body.

When the tray 51 has moved to the lowermost position N indicated by the dashed line, the discharging roller 63 is located at the position corresponding to roller holes 98 of the tray 51 illustrated in FIG. 5, and parts of the discharging roller 63 come out through the roller holes 98 to the upper surface of the tray 51. At this time, if a side guide plate 83 is located at a "T" position to align sheets 4, a stack of sheets 4 on the tray 51 are sandwiched by an upper plate 69 of the side guide plate 83 and the discharging roller 63. Further, the discharging roller 63 is configured such that the position of a rotation center thereof relative to the stack of sheets 4 on the tray 51 can be moved. The discharging roller 63 is pressed by a spring to a predetermined position, so that when discharging the stack of sheets 4 on the tray 51, regardless of the thickness of the stack of sheets 4, the stack of sheets 4 is sandwiched by the upper plate 69 of the side guide plate 83 and the discharging roller 63 by a predetermined pressure, and the stack of sheets 4 is discharged to a discharging outlet 10.

[0026]

The binding part 8 illustrated in FIG. 4 includes a stapler 75 having an opening part in which leading edges of a stack of

sheets 4 are put in and aligned, a stopper 71, and an axis 72 serving as a rotation center of the stopper 71. The stopper 71 is usually caused to be located at a "J" position for positioning leading edges of the stack of sheets 4 with a spring 73 and a positioning pin 76, and is swung to a "K" position by a solenoid 74.

[0027]

FIG. 5 illustrates the tray 51 viewed from the above. An end guide plate 80 and the side guide plate 83 are arranged on the upper surface of the tray 51 which swings around the E axis 52 fixed to the side plates of the main body. The end guide plate 80 includes an "En" motor 82, an "En" pulley 94, an "E" pulley 95, an "E" belt 96, and an "En" pinion 97, which are provided to the backside surface of the tray 51, and an "En" rack 93 mounted to the backside surface of the tray 51 integrally with the end guide plate 80. The end guide plate 80 is moved to a binding position "P" based on the position of an "E" sensor 81 with rotation of the En motor 82. The sensor 81 is provided at a reference position "R", that is the outermost position to which the end guide plate 80 can move, and the end guide plate 80 is controlled by the control device, not shown, to move to the reference position R, the binding position P, and a discharging position "Q", to which the stack of sheets 4 is returned from the opening part of the stapler 75 after having been stapled.

[0028]

In this example, the side guide plate 83 is arranged at

each side part of the tray 51 symmetrically with respect to the center of a sheet 4 in the direction in which the sheet 4 is received. However, the side guide plate 83 at one side part of the tray 51 may be fixed and the side guide plate 83 at the other side part of the tray 51 may move. A pin 85 of the side guide plate 83 engages with a guide hole 84 provided in the tray 51, and a rack plate 88 fixed to the backside surface of the side guide plate 83 is moved by a pinion 87 which is driven by an "S" motor 92, and thereby the side guide plate 83 can be moved from a reference position "S" to the T position. A sensor 86 is arranged to detect the side guide plate 83 at the reference position S, and the side guide plate 83 is moved from the reference position S to the T position under control of the control device.

[0029]

Now, the operation of the sheet processing apparatus 3 will be described.

When the power of the sheet processing apparatus 3 has been turned on, the moving guide plate 23 is moved to the G position, the tray 51 of the jogging part 7 is moved to the uppermost position M, and then the E motor 62 stops. The A stopper 71 moves to the J position by turning off of the solenoid 74, and the end guide plate 80 of the tray 51 moves to the R position with rotation of the En motor 82. The side guide plate 83 is moved to the S position with rotation of the S motor 92. The stapler 75 is put in the standby status.

[0030]

When the first sheet 4 has been conveyed from the printer 2 and the sheet 4 conveyed to the receiving part 11 of the sheet waiting part 6 has been detected by the A sensor 24, the A motor 30 and the C motor 49 start to rotate. In this case, the A roller 25, the B roller 26, the C roller 41, and the D roller 42 rotate at the circumferential speed corresponding to the speed at which the sheet 4 is conveyed from the printer 2. The sheet 4 is conveyed by the pair of the A roller 25 and the B roller 26 and the pair of the C roller 41 and the D roller 42, and is discharged onto the tray 51. At this time, after a predetermined time after detection of the trailing edge of the sheet 4 with the C sensor 44, the end guide plate 80 provided to the tray 51 is moved to the stapling position P with rotation of the En motor 82 to push the sheet 4 against the A stopper 71, and the end guide plate 80 then returns to the reference position R. The side guide plates 83 also move from the reference positions S to the T positions with rotation of the S motor 92 to align the side edges of the sheet 4 and then return to the reference positions S.

[0031]

Then, the second sheet 4 is conveyed from the printer 2. A predetermined time after the C sensor 44 has detected the trailing edge of the second sheet 4, the end guide plate 80 and the side guide plates 83 align the second sheet 4, and return to the reference position R and the reference positions S, respectively. Similarly, the last sheet 4 of a group of sheets 4 to be bound is conveyed from the printer 2. According to an instruction from the control device for the last sheet 4 to be

bound, the side guide plates 83 and the end guide plate 80 move to and stop at the binding positions, i.e., at the T positions and the P position, respectively, and the stapler 75 starts an operation of stapling the group of sheets 4 according to an instruction from the control device. The stapler 75 staples the group of sheets 4 at predetermined positions and returns to the standby status, the side guide plate 83 slightly loosens pressing to the stack of sheets 4, which is the bound group of sheets 4, and move about 1mm in the direction indicated by the arrow Y in FIG. 5 so that the stack of sheets 4 can be easily moved, and the end guide plate 80 moves from the P position to the Q position. After a predetermined time, the solenoid 74 is operated and the stopper 71 moves from the J position to the K position, and thereby the stapled stack of sheets 4 is pushed out of the opening part of the stapler 75 and the rear end of the stapled stack of sheets 4 at the opposite side of the stapled side is located at the Q position, and the stopper 71 is then returned to the J position.

[0032]

Thereafter, the E motor 62 starts to rotate and the tray 51 starts to move from the M position to the N position illustrated by the dashed line in FIG. 4. When the E motor 62 starts to rotate, the motor 67 also starts to rotate at the same time and the discharging roller 63 rotates in the direction indicated by the arrow. Further, the end guide plate 80 is moved from the Q position to the P position and pushes the stack of sheets 4 toward the discharging outlet 10. The tray 51 is moved

to the N position, the lowermost position illustrated by the dashed line, the stack of sheets 4 is sandwiched by the discharging roller 63 and the upper plates 69 of the side guide plates 83, and the stack of sheets 4 is discharged to the discharging outlet 10 down below with rotation of the discharging roller 63. The D sensor 68 detects the trailing edge of the stack of sheets 4, and then the end guide plate 80 returns from the P position to the reference position R and the side guide plates 83 return to the reference positions S. Thereafter, the E motor 62 starts to rotate, the sensor 53 detects the tray 51, and the E motor 62 stops, so that the tray 51 is positioned at the reference position M with the upper side stopper 54, and thereby the binding operation ends.

[0033]

When binding one set of sheets, the binding operation of the sheet processing apparatus 3 is normally performed as described above. When binding plural sets of sheets consecutively, the binding operation is performed as described below.

When binding plural sets of sheets consecutively, while the binding operation of step 11-3 illustrated in FIG. 11 is being performed, next sheets 4 to be bound are conveyed from the printer 2 in succession. While the binding operation is being performed to the previous set of sheets 4, that is, between the step 11-12 and the step 11-24 of FIG. 11, until the D sensor 68 provided to the tray 51 detects discharging of the previous set of sheets 4 and the tray 51 returns to the M position, it

is determined as that the binding operation is being performed. When the tray 51 has returned to the M position and the sensor 53 has detected the tray 51, the control device determines as that the binding operation of step 11-3 has been completed.

[0034]

When it has been determined as that the binding operation is being performed, in the processes of steps 11-10 and 11-11, the A sensor 24 of the receiving part 11 detects the sheet 4, the A roller 25 and the B roller 26 start rotating, and thereby the sheet 4 is received, and the C roller 41 and the D roller 42 rotate at the circumferential speed of one twentieth of the speed V of the A roller 25 and the B roller 26 according to an instruction from the control device. Because the A roller 25 and the B roller rotate at the speed V, the sheet 4 conveyed by the A roller 25 and the B roller 26 and pinched by the C roller 45 and the D roller 46 slacks and the slack of the sheet 4 gradually increases.

[0035]

When the leading edge of the sheet 4 has been pinched between the C roller 41 and the D roller 42, the B motor 35 starts to rotate, and the moving guide plate 23 rotates by a predetermined angle to move from the G position to the H position. Because the sheet 4 being conveyed by the A roller 25 and the B roller 26 is pinched between the C roller 41 and the D roller 42 at the leading edge thereof and is guided by the upper guide plate 21 at the upper surface thereof, the sheet 4 downwardly bulges toward the open area 13. Thereafter, the trailing edge

of the sheet 4 is finally released from the A roller 25 and the B roller 26, and the trailing edge of the sheet 4 is discharged into the open area 13 due to the weight of the sheet 4. After the trailing edge of the sheet 4 has been sufficiently discharged into the open area 13, the B motor 35 rotates and the moving guide plate 23 is returned to the reference position G, and the next sheet 4 is waited.

[0036]

The next sheet 4 is conveyed in a similar manner while sliding over the previously conveyed and pinched sheet 4, and when the leading edge thereof is pinched between the C roller 41 and the D roller 42, the leading edge of the next sheet 4 is shifted by a distance "d" from the leading edge of the previously conveyed sheet 4. The previously conveyed sheet 4 and the next sheet 4 are both pinched between the C roller 41 and the D roller 42 with the leading edge of the next sheet 4 shifted from that of the previously conveyed sheet 4 and wait for the following sheet 4 to be conveyed, while being pinched and conveyed by the C roller 41 and the D roller 42.

[0037]

The aim of causing sheets 4 to be held to be further conveyed is attained as long as the sheets 4 can be pinched by the C roller 41 and the D roller 42 as the second roller pair with leading edges thereof shifted stepwise one after another, and the distance d between the leading edges of the sheets 4 may be sufficient if it is greater than about 5mm.

[0038]

As a method for pinching sheets 4 between the C roller 41 and the D roller such that the leading edges of the sheets 4 shifted stepwise one after another, the C roller 41 and the D roller 42 are rotated at a decreased speed. For example, if the circumferential speed of the C roller 41 and the D roller 42 is decreased to one half of that of the A roller 25 and the B roller 26, when a sheet 4 received by the C roller 41 and the D roller 42 is conveyed by about one half of a length of the sheet 4 with the C roller 41 and the D roller 42, the next sheet 4 reaches the C roller 41 and the D roller 42. In this case, disregarding a distance between sheets, two sheets 4 can be pinched between the C roller 41 and the D roller 42 to be held. If the circumferential speed of the C roller 41 and the D roller 42 is decreased to one twentieth of that of the A roller 25 and the B roller 26, about twenty sheets 4 can be pinched between the C roller 41 and the D roller 42 to be held.

[0039]

There is another method for pinching sheets 4 between the C roller 41 and the D roller 42 such that the leading edges of the sheets 4 are shifted stepwise one after another, in which the C roller 41 and the D roller 42 are stopped to wait for the next sheet 4 to arrive after the A roller 25 and the B roller 26 have conveyed the sheet 4 at the circumferential speed V by a distance between a nip point of the A roller 25 and the B roller 26 and that of the C roller 41 and the D roller 42 added by the shifted distance d. More specifically, the A sensor 24 detects the sheet 4, the A roller 25 and the B roller 26 convey the sheet

4 at the circumferential speed V, the C roller 41 and the D roller 42 start to rotate at the timing the sheet 4 reaches the C roller 41 and the D roller 42, the C roller 41 and the D roller 42 convey the sheet 4 by the distance d, and then the C roller 41 and the D roller 42 stop. In this case, the circumferential speed of the C roller 41 and the D roller 42 can be the same as that of the A roller 25 and the B roller 26, but it is preferable that the circumferential speed of the C roller 41 and the D roller 42 is slower from the viewpoint of the stability. The C roller 41 and the D roller 42 may be continuously rotated at a decreased speed, which is convenient for control.

[0040]

After the stack of sheets 4 on the tray 51 has been stapled and the stapled stack of sheets 4 has been discharged to the discharging outlet 10, a predetermined time after the tray 51 has returned to the M position, an instruction that the binding operation has been completed is issued from the control device not shown. Then, the C roller 41 and the D roller driven by the motor 49 are rotated at the same circumferential speed as that of the A roller 25 and the B roller 26, and a plurality of sheets 4 pinched and held between the C roller 41 and the D roller 42 with leading edges thereof shifted stepwise are discharged onto the tray 51 by the C roller 41 and the D roller 42.

[0041]

The sheets 4 discharged onto the tray 51 are aligned at the binding position by the side guide plates 83 and the end

guide plate 80, and wait for subsequent sheets 4 to be conveyed. Subsequent sheets 4 are conveyed from the printer 2 one after another and are discharged onto the tray 51 one after another, and are aligned at the binding position. A predetermined time after the trailing edge of the last sheet 4 of a group of sheets 4 to be bound has been detected with the C sensor 44, the binding operation starts. On the other hand, a next group of sheets 4 to be bound are received from the printer 2 one after another and are caused to wait at the waiting part 12 of the sheet waiting part 6 in the same manner as described above, so that binding can be performed in succession.

[0042]

FIG. 6 illustrates a state that sheets 4 are held at the waiting part 12 of the sheet waiting part 6 to be further conveyed. As illustrated, the sheets 4 are pinched between the C roller 41 and the D roller 42 with leading edges thereof shifted stepwise one after another by the distance d. The amount of d is determined based on the number of sheets 4 to be held or the waiting time. After the binding operation has been completed, the sheets 4 pinched between the C roller 41 and the D roller 42 are conveyed by the C roller 41 and the D roller 42 at the circumferential speed V, which is the same as that of the A roller 25 and the B roller 26, to be discharged onto the tray 51.

[0043]

FIG. 7 illustrates another example of the sheet waiting part 6 of the sheet processing apparatus 3, in which the moving

guide plate 23 is not used. As illustrated in figure, a protrusion part 50 is provided in the upper guide plate 21, so that when a sheet 4 is conveyed by the A roller 25 and the B roller 26, the sheet 4 is directed slightly downward by the protrusion part 50. The sheet 4 then reaches the cover 48 and is guided to be pinched between the C roller 41 and the D roller 42 rotating at the speed decreased to one twentieth of the circumferential speed V of the A roller 25 and the B roller 26. At this time, because the trailing edge part of the sheet 4 is conveyed by the A roller 25 and the B roller 26 at the circumferential speed V, the sheet 4 is caused to bulge, and the bulge thereof is directed toward the open area 13 by the protrusion part 50, and finally the trailing edge part of the sheet 4 is discharged into the open area 13. By forming the cover 48 such that the first sheet 4 reaches between the C roller 41 and the D roller 42, a subsequent sheet 4 is conveyed while sliding over the previously conveyed and pinched sheet 4, so that the subsequent sheet 4 is stably guided to be pinched between the C roller 41 and the D roller 42.

[0044]

FIG. 8 illustrates another example of the sheet waiting part 6 of the sheet processing apparatus 3, in which the protrusion part 50 is not provided in the upper guide plate 21, and instead a fan 16 serving as a device for causing the sheet 4 to bulge toward the open area 13 is arranged above the upper guide plate 21, i.e., at the opposite side of the open area 13. When the sheet 4 has been pinched between the C roller 41 and

the D roller 42 at the leading edge thereof, the fan 16 blows the air in the arrow direction in figure, so that the sheet 4 bulges toward the open area 13. Further, a rotating guide plate 37 is arranged to stably guide the sheet 4 to be pinched between the C roller 41 and the D roller 42. The rotating guide plate 37 is positioned at a "W" position when guiding the sheet 4 to be pinched between the C roller 41 and the D roller 42 and is moved to be positioned at an "X" position when discharging the trailing edge of the sheet 4 into the open area 13.

[0045]

FIG. 9 illustrates another example of the sheet waiting part 6 of the sheet processing apparatus 3, in which a sheet pushing plate 39 as a device to bulge the sheet 4 toward the open area 13 is provided. Further, the rotating guide plate 37 is provided to surely guide the sheet 4 to be pinched between the C roller 41 and the D roller 42. When the binding operation is not being performed, the A roller 25, the B roller 25, the C roller 41, and the D roller 42 rotate at the circumferential speed V, and the sheet pushing plate 39 is positioned at a "P" position and the rotating guide plate 37 is positioned at the W position.

[0046]

When a sheet 4 is received from the printer 2 while the binding operation is being performed at the binding part 8, the A sensor 24 detects the sheet 4, the A roller 25 and the B roller 26 rotate at the circumferential speed V, the C roller 41 and the D roller 42 rotate at a decreased circumferential speed,

and at the same time when the sheet 4 is pinched between the C roller 41 and the D roller 42 at the leading edge thereof, the rotating guide plate 37 is rotated by a solenoid, not illustrated, from the W position to the X position around an axis 38 and the sheet pushing plate 39 is also rotated by a solenoid, not illustrated, from the P position to an "Q" position around an axis 15. Thereby, the bulge of the sheet 4 pinched between the C roller 41 and the D roller 42 at the leading edge thereof is directed toward the open area 13, and finally the trailing edge of the sheet 4 is discharged into the open area 13. A predetermined time thereafter, the rotating guide plate 37 returns to the W position and the sheet pushing plate 39 returns to the P position to wait for the next sheet 4.

[0047]

FIG. 10 illustrates another example of the sheet waiting part 6 of the sheet processing apparatus 3, in which neither a bulging device nor a rotating guide plate is used. In this example, a distance "L" between the nip of the A roller 25 and the B roller 26 as the first roller pair and that of the C roller 41 and the D roller 42 as the second roller pair is set at a length close to the length of the sheet 4. In this case, it is not necessary to cause the sheet 4 to be bulged, so that a member for bulging the sheet 4 is not needed, and the opening part 13 is provided so that the trailing edge of the previous sheet 4 is retreated and the leading edge of the next sheet 4 will not collide with the trailing edge of the previous sheet

4. The cover 48 is formed such that the leading edge of the sheet 4 smoothly reaches between the C roller 41 and the D roller 42.

[0048]

[The Effect of the Invention]

According to the present invention, by providing a sheet waiting device above a binding tray of a sheet processing apparatus, even when a printer discharges sheets 4 at a high speed while a binding operation is being performed on the binding tray, the discharged sheets 4 are received by the sheet processing apparatus and are held at the sheet waiting device until the binding operation is completed, so that it is not necessary to stop the printer while sheet processing is being performed by the sheet processing apparatus, and thus highly efficient work can be performed.

Further, in the sheet processing apparatus, a large number of sheets 4 can be held by a simple mechanism occupying a small space under a simple control of a roller pair provided to a sheet conveyance path, and even when the sheet processing apparatus is connected with a high speed printer, sheet processing, such as binding, etc., can be performed without wasting time. Furthermore, even when a binding error occurs on the binding tray, sheets 4 processed by the printer are received and held by the waiting device, so that the printer needs not to be stopped, and thereby dealing with the sheets 4 as jammed sheets is avoided.

[Brief Description of the Drawings]

FIG. 1 is a schematic diagram of a system in which a sheet processing apparatus of the present invention is connected with an image forming apparatus controlled by an image formation controller.

FIG. 2 is a cross section illustrating an exemplary construction of the sheet processing apparatus.

FIG. 3 is a cross section illustrating an exemplary construction of a sheet waiting part of the sheet processing apparatus.

FIG. 4 is a cross section illustrating an exemplary construction of a jogging part, a binding part, and a discharging part of the sheet processing apparatus.

FIG. 5 is a plan view for explaining the jogging part.

FIG. 6 is diagram illustrating a state that sheets are held at the sheet waiting part.

FIG. 7 is a cross section illustrating another exemplary construction of the sheet waiting part.

FIG. 8 is a cross section illustrating still another exemplary construction of the sheet waiting part.

FIG. 9 is a cross section illustrating still another exemplary construction of the sheet waiting part.

FIG. 10 is a cross section illustrating still another exemplary construction of the sheet waiting part.

FIG. 11 is a flowchart of a part of an exemplary operation of the sheet processing apparatus.

FIG. 12 is a flowchart of a part of the exemplary operation of the sheet processing apparatus continuing from FIG. 11.

[Explanation of Symbols]

1: PC

2: printer

3: sheet processing apparatus

4: sheet

6: sheet waiting part

7: jogging part

8: binding part

9: discharging part

11: receiving part

12: waiting part

[FIG. 11]

11-1: START

11-2: HAS A SHEET BEEN DETECTED?

11-3: IS A BINDING OPERATION BEING PERFORMED?

11-4: FIRST ROLLER PAIR (25, 26) ROTATE AT THE V SPEED

11-5: SECOND ROLLER PAIR (41, 42) ROTATE AT THE V SPEED

11-6: HAS THE SHEET BEEN DISCHARGED ONTO A TRAY 51?

11-7: SIDE GUIDE PLATES 83 MOVE FROM S POSITIONS TO T POSITIONS AND RETURN TO S POSITIONS

11-8: END GUIDE PLATE 80 MOVES FROM R POSITION TO P POSITION AND RETURNS TO R POSITION

11-9: IS THE SHEET THE LAST SHEET 4 TO BE BOUND?

11-10: FIRST ROLLER PAIR (25, 26) ROTATE AT THE V SPEED

11-11: SECOND ROLLER PAIR (41, 42) ROTATE AT 1/20 OF THE V SPEED

11-12: SIDE GUIDE PLATES 83 AND END GUIDE PLATE 80 MOVE TO AND

STOP AT BINDING POSITIONS (T POSITIONS AND P POSITION)

11-13: STAPLER STAPLES A STACK OF SHEETS

11-14: HAS STAPLER RETURNED TO STANDBY STATUS?

11-15: SIDE GUIDE PLATES 83 MOVE IN ARROW DIRECTION 1MM FROM T POSITIONS

11-16: END GUIDE PLATE 80 MOVES FROM P POSITION TO R POSITION

11-17: STOPPER 71 MOVES FROM J POSITION TO K POSITION AND RETURNS to J POSITION

11-12 : BINDING OPERATION STARTS

FROM 11-12 TO 11-24 (FIG. 12): BINDING OPERATION IS BEING PERFORMED

11-14 : TROUBLE

[FIG. 12]

11-18: TRAY 51 MOVES FROM M POSITION TO N POSITION

11-19: DISCHARGING ROLLER ROTATES

11-20: END GUIDE PLATE 80 MOVES FROM Q POSITION TO P POSITION

11-21: HAS THE TRAILING EDGE OF THE STAPLED STACK OF SHEETS BEEN DETECTED BY SENSOR 68?

11-22: TRAY 51 MOVES FROM N POSITION TO M POSITION

11-23: END GUIDE PLATE 80 MOVES FROM P POSITION TO R POSITION AND SIDE GUIDE PLATES 83 MOVE TO S POSITIONS

11-24: HAS THE TRAY 51 AT M POSITION BEEN DETECTED BY SENSOR 53?

11-24 : BINDING OPERATION ENDS

11-21: TROUBLE

11-24 : TROUBLE